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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/050,518	01/18/2002	Masaaki Nanaumi	Q68110	7763

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EXAMINER	
TSANG FOSTER, SUSY N	

ART UNIT	PAPER NUMBER
1745	

DATE MAILED: 09/08/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/050,518	NANAUMI ET AL.	
	Examiner	Art Unit	
	Susy N Tsang-Foster	1745	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *07 June 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,4-10 and 12-17* is/are pending in the application.

4a) Of the above claim(s) *13-15* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,4-10,12,16 and 17* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. This Office Action is responsive to the amendment filed 6/7/2004. Claims 1, 10, and 16 have been amended. Claims 2, 3, and 11 have been cancelled. Claims 1, 4-10, and 12-17 are pending. Claims 13-15 are withdrawn from further consideration as being drawn to a nonelected invention. In view of applicant's translation of the certified foreign priority documents, the art rejections based on Fukuda et al. in the previous Office Action are withdrawn. The obviousness type double patenting rejections in the previous office action are withdrawn in view of the current amendment to instant claim 1. Claims 1, 4-10, 12, 16, and 17 are finally rejected for reasons of record and for reasons necessitated by applicant's amendment.

Specification

2. The amendment filed 6/7/2004 is objected to under 35 U.S.C. 132 because it introduces new matter into the disclosure. 35 U.S.C. 132 states that no amendment shall introduce new matter into the disclosure of the invention. The added material which is not supported by the original disclosure is as follows:

On page 6, in the paragraph beginning at line 7, the insertion of the phrase "polymer electrolyte membrane in the" constitutes new matter.

On page 6, in the paragraph beginning at line 10, insertion of the phrase "polymer electrolyte membrane in the" constitutes new matter.

In the paragraph bridging pages 8 and 9, the insertion of the phrase "the polymer electrolyte membrane having" constitutes new matter.

On page 10, in the paragraph beginning at line 10, the insertion of the phrase "the polymer electrolyte membrane in" constitutes new matter.

On page 30, in the paragraph beginning at line 9, the insertion of the phrases "the polymer electrolyte membrane in" and "of a single cell" constitutes new matter.

On page 31, in the paragraph beginning at line 8, insertion of the phrase "polymer electrolyte membrane in the" constitutes new matter.

Applicant is required to cancel the new matter in the reply to this Office Action.

3. The disclosure is objected to because of the following informalities:

It is unclear to the Examiner what the Q value means since there appears to be contradictions throughout the specification and it is a term not known to one of ordinary skill in the art to characterize a polymer electrolyte membrane or a membrane electrode assembly by a Q value.

In paragraph 39 of the specification, applicants states that:

> "... the polymer electrolyte membrane should have a Q value (charge per a unit area) of 0.09-0.18 C/cm^2...Here, the Q value is the amount of electric charge per a unit area determined from a peak area of proton on an adsorption side in the scanning of voltage from -0.1 V to +0.7 V, in a cell in which the amount of platinum in the catalytic layer of each electrode is 0.5 mg/cm^2, and in which a polymer electrolyte membrane electrode assembly is surrounded by an aqueous sulfuric acid solution of pH 1 on one side and a nitrogen gas on the other side. The Q value may be regarded as all indicator of adhesion of the electrode to

the polymer electrolyte membrane, and it has been found that with the Q value of 0.09-0.18 C/cm^2, an excellent polymer electrolyte membrane electrode assembly is obtained. "

As seen in paragraph 39, the Q value limits each of the electrode to have a catalyst loading of 0.5 mg/cm^2 by definition. It also appears to be a contradiction of what the Q value is since it states the polymer electrolyte membrane should have a certain Q value and at the same time the specification also states that the Q value may be regarded as an indicator of adhesion of the electrode to the polymer electrolyte membrane.

Further contradiction of what the value Q means appears to be in paragraph 42 which states:

"the Q value is defined as the amount of electric charge per a unit area of the membrane electrode assembly, indicating that the larger the Q value, the higher the adhesion of the electrode 100 to the polymer electrolyte membrane 101".

Finally, paragraph 135 of the specification states that the Q value of each membrane assembly was measured in a range from –0.1 V to +0.7V .

Thus, it is unclear to the Examiner how the polymer electrolyte membrane can be characterized by a Q value that appears to be arbitrarily defined by applicant.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 5-9, 16, and 17 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 5, the limitation "said polymer electrolyte membrane having a softening point of 120 °C or more and a Q value of 0.09-0.18 C/cm^{2}" is indefinite because it is unclear to the Examiner what the Q value means since there appears to be contradictions throughout the specification and it is a term not known to one of ordinary skill in the art to characterize a polymer electrolyte membrane or a membrane electrode assembly by a Q value for reasons stated above.

The Q value claimed is not a property of the polymer electrolyte membrane but the Q value of the membrane electrode assembly that depends on a variety of factors such as the degree of adhesion of the electrode to the polymer electrolyte membrane (as stated by applicant in his specification), concentration of catalyst on the electrode, the degree of ion exchange capacity of the polymer electrolyte membrane, and the operating current density of the membrane electrode assembly in the fuel cell (such as the ramping voltage used to measure the Q value). Even if the Q value is claimed for the membrane electrode assembly, the value Q is indefinite because the value varies depending on many factors such as catalyst loading for each electrode, degree of ion exchange capacity of the polymer electrolyte membrane, and operating current density of the fuel cell.

As evidenced by the specification, paragraph 39 of the corresponding PG Publication US 2002/0155340 A1 states that "Q may be regarded as an indicator of adhesion of the electrode to

the polymer electrolyte membrane, and it has been found that with the Q value of 0.09-0.18 C/cm^2, an excellent polymer electrolyte membrane electrode assembly is obtained." Paragraph 42 of the specification also states "the Q value is defined as the amount of electric charge per a unit area of the membrane electrode assembly, indicating that the larger the Q value, the higher the adhesion of the electrode 100 to the polymer electrolyte membrane 101."

The value Q depends on a variety of conditions such as catalyst loading, degree of adhesion of the electrode to the catalyst layer, and the operating current density of the membrane electrode assembly in the fuel cell and it is not a property of the polymer electrolyte membrane. Furthermore, there is no recognition in the art using the value Q as defined by applicant to characterize the polymer electrolyte membrane in a membrane electrode assembly. The value Q only exists under a given set of operating conditions not claimed for a fuel cell comprising the membrane electrode assembly.

Claims depending from claims rejected under 35 USC 112, second paragraph are also rejected for the same.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

7. Claims 1, 4, and 12 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Spiewak et al. (US Pat. No. 6,136,412).

See col. 2, lines 57-67; col. 3, lines 30-61; col. 7, lines 20-30; col. 8, lines 4-35; col. 15, lines 49-55; col. 16, lines 23-26; col. 20, lines 48-61; col. 21, lines 42-54 of the reference.

8. Claims 1, 4, and 12 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Swathirajan et al. (US Pat. No. 5,272,017).

See Abstract; Figure 2; col. 2, lines 3-30; col. 4, lines 42-50; col. 7, lines 30-42 of the reference.

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

10. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Spiewak et al. (US Pat. No. 6,136,412) in view of Yen et al. (US Pat. No. 5,795,496).

Spiewak et al. (US Pat. No. 6,136,412) disclose all the limitations of claim 10 (see above) except that the sulfonated hydrocarbon polymer is sulfonated polyetheretherketone. Spiewak et al. do disclose the use of sulfonated hydrocarbon polymer as the ion -exchange resin in the

membrane of the membrane electrode assembly and NAFION (col. 16, lines 23-26).

Yen et al. teach that sulfonated polyetheretherketone is stable at higher temperatures of operation of the membrane electrode assembly in a fuel cell compared to NAFION and that the sulfonated polyetheretherketone has low methanol permeability, high proton conductivity, and is inexpensive and readily available (col. 2, lines 19-28).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use sulfonated polyetheretherketone as the ion exchange resin membrane in the membrane electrode assembly (MEA) of Spiewak et al. because sulfonated polyetheretherketone is stable at high temperatures of operation of the membrane electrode assembly in a fuel cell when compared to NAFION and that the sulfonated polyetheretherketone has low methanol permeability, high proton conductivity and is inexpensive and readily available.

11. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Swathirajan et al. (US Pat. No. 5,272,017) in view of Yen et al. (US Pat. No. 5,795,496).

Swathirajan et al. (US Pat. No. 5,272,017) disclose all the limitations of claim 10 above except that the sulfonated hydrocarbon polymer is sulfonated polyetheretherketone. Swathirajan et al. do disclose NAFION as the ion exchange resin in the membrane (col. 4, lines 42-50).

Yen et al. teach that sulfonated polyetheretherketone is stable at higher temperatures of

operation of the membrane electrode assembly in a fuel cell compared to NAFION and that the sulfonated polyetheretherketone has low methanol permeability, high proton conductivity, and is inexpensive and readily available (col. 2, lines 19-28).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use sulfonated polyetheretherketone as the ion exchange resin membrane in the membrane electrode assembly (MEA) of Swathirajan et al. because sulfonated polyetheretherketone is stable at high temperatures of operation of the membrane electrode assembly in a fuel cell when compared to NAFION and that the sulfonated polyetheretherketone has low methanol permeability, high proton conductivity and is inexpensive and readily available.

Response to Arguments

12. Applicant's arguments filed 6/7/2004 have been fully considered but they are not persuasive.

Applicant states on page 11 of the amendment that since "the structure of the membrane electrode assembly of the single cell used for measuring the Q value of the polymer electrolyte membrane does not have a perfect structure as the polymer electrolyte membrane electrode assembly used for the polymer electrolyte fuel cell, its Q value should not be referred to as "the Q value of the membrane electrode assembly" but should be referred to as the "Q value of the polymer electrolyte membrane".

The Examiner is not persuaded by applicant's arguments since it appears that applicant is admitting that the Q value is not an inherent property of the polymer electrolyte membrane but it is regarded as the Q value of the electrolyte membrane because its measurement does not involve a complete membrane electrode assembly.

The Q value claimed is not a property of the polymer electrolyte membrane but the Q value of the membrane electrode assembly that depends on a variety of factors such as the degree of adhesion of the electrode to the polymer electrolyte membrane (as stated by applicant in his specification), concentration of catalyst on the electrode, the degree of ion exchange capacity of the polymer electrolyte membrane, and the operating current density of the membrane electrode assembly in the fuel cell (such as the ramping voltage used to measure the Q value). Even if the Q value is claimed for the membrane electrode assembly, the value Q is indefinite because the conditions under which the value of Q was obtained are not claimed (e.g., catalyst loading for each electrode, degree of ion exchange capacity of the polymer electrolyte membrane, and operating current density of the fuel cell).

As evidenced by the specification, paragraph 39 of the corresponding PG Publication US 2002/0155340 A1 states that "Q may be regarded as an indicator of adhesion of the electrode to the polymer electrolyte membrane, and it has been found that with the Q value of 0.09-0.18 C/cm^2, an excellent polymer electrolyte membrane electrode assembly is obtained." Paragraph 42 of the specification also states "the Q value is defined as the amount of electric charge per a unit area of the membrane electrode assembly, indicating that the larger the Q value, the higher the adhesion of the electrode 100 to the polymer electrolyte membrane 101."

The value Q depends on a variety of conditions such as catalyst loading, degree of adhesion of the electrode to the catalyst layer, and the operating current density of the membrane electrode assembly in the fuel cell and it is not a property of the polymer electrolyte membrane. Furthermore, there is no recognition in the art using the value Q as defined by applicant to characterize the polymer electrolyte membrane in a membrane electrode assembly. The value Q only exists under a given set of operating conditions not claimed for a fuel cell comprising the membrane electrode assembly.

With respect to Spiewak et al of record, applicant argues that Spiewak is silent regarding the distance in wave form along the interface and that the catalyst electrode are incorporated into very thin surface layers, localized within 2 microns of the interface on either side of the ion conductive membrane (ICM) and that the catalyst electrode particles are in incomplete contact with the ICM.

In response, column 20, lines 48-65 of the Spiewak et al. reference state that Figures 5(a), 5(b), and 5 (c) are scanning electron micrographs of a cross section of an MEA surface where the nanostructured electrode layer conforms to microtextured shape of 25 microns high peaks and valleys and that the ion conductive membrane (ICM or electrolyte membrane) and the electrode backing layer (EBL) are interleaved. Column 21, lines 42-46 of the reference also disclose that the thickness of the catalyzed region of the ion conductive membrane (ICM), that is the degree of penetration by the catalyst layer, is 2 microns or less. As seen in Figures 5a and 5b, the linear distance of 50 microns (between the two adjacent bottom vertices) is smaller than the interface distance by the factor of the square root of 2 or 1.414 such that the interface distance is greater

than the linear distance by 15% or more. As stated at column 20, lines 60-65, the angle of the surface of the microtextured surface is 45 degrees.

The Spiewak et al. reference also discloses in column 4 that the nanostructure element can have incomplete contact with the ICM such that the nanostructure elements can have one end embedded in the ICM and another end protruding from the ICM (col. 4, lines 19-37). Incomplete contact in the Spiewak reference means partially embedding of the catalyst support particles (col. 7, lines 20-45).

Furthermore, the instant claims do not recited the distance in wave form along the interface. The instant claims recite "the distance along said interface." Nevertheless, a sawtooth triangular pattern along the interface as shown in Figures (a)-(c) of Spiewak et al. is a waveform.

With respect to Swathirajan, applicant argues that Swathirajan does not teach or suggest any projection of the catalyst layer and any distance along the interface.

In response, Swathirajan at column 2, lines 3-30 specifically discloses that the catalyst slurry is heated while being pressed to the membrane for a time and at a temperature and compressive loading sufficient to soften the membrane and at least partially embed at least a portion of the catalyst particles in the membrane. It is noted that the method disclosed in Swathirajan in making the membrane electrode assembly (col. 2, lines 51-65) is identical to that disclosed by the instant specification such that the claimed properties of the membrane electrode assembly in the instant claims are inherent in the membrane electrode assembly of Swathirajan.

Conclusion

13. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL.** See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications should be directed to examiner Susy Tsang-Foster, Ph.D. whose telephone number is (571) 272-1293. The examiner can normally be reached on Monday through Friday from 9:30 AM to 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached at (571) 272-1292.

The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications

may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

st/ Susy Tsang-Foster

Susy Tsang-Foster
Primary Examiner
Art Unit 1745